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FLOOD INSURANCE STUDY

VILLAGE OF BRIDGEPORT, OHIO
BELMONT COUNTY

JUNE 1981

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 390026

FEMA 209

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Panel 390026 0001B

FLOOD INSURANCE STUDY

VILLAGE OF BRIDGEPORT,
BELMONT COUNTY, OHIO

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the Village of Bridgeport, Belmont County, Ohio, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert the Village of Bridgeport to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain management.

1.2 Coordination

Community base map selection and the identification of streams requiring detailed study were done in a meeting attended by personnel of the U.S. Army Corps of Engineers (COE), the Federal Insurance Administration, and officials of the Village of Bridgeport Planning Department on January 21, 1976.

During the course of the study, flood elevations, flood boundaries, and floodway delineations were reviewed with city officials and with officials of the State Department of Natural Resources. The results of the study were reviewed and accepted at a final consultation and coordination meeting held on February 14, 1978 . It was attended by personnel of the COE, the Federal Insurance Administration, the Village Planning Department, local officials, and interested citizens.

1.3 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers, Pittsburgh District, for the Federal Insurance Administration, under Inter-Agency Agreement No. (IAA)-H-7-76, Project Order No. 20, and Inter-Agency Agreement No. (IAA)-H-10-77, Project Order No. 1. This work, which was completed in July 1977, covered all significant flooding sources affecting the Village of Bridgeport.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the entire incorporated area of the Village of Bridgeport. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, areas of projected development and proposed construction until July 1979.

Approximate methods of analysis were used to study those areas having low development potential and/or minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by the Federal Insurance Administration and the community.

Floods caused by overflow of the Ohio River and Wheeling Creek, within the corporate limits, were studied in detail. Smaller tributaries of the two streams within the village were studied by approximate methods.

2.2 Community Description

The Village of Bridgeport is located in northeast Belmont County in east-central Ohio. The Ohio River forms the boundary between the states of West Virginia and Ohio. Bridgeport is located on the east shore of the Ohio River and Wheeling City, West Virginia is located across from Bridgeport on the west shore. Bridgeport has a 1970 population of 3,001 (Census) as compared to the 1960 population of 3,824 (Census).

The village was first laid out in 1806 by Ebenezer Zane and was called Canton. The name Canton was changed to Bridgeport and the community was incorporated on March 14, 1836. In 1873, the corporate limits were extended to the present north line of Aetanville and south of the Labelle Glass Works. Early industries other than boat building included the making of sheet and building iron, corrugated iron, cut glass doors, sash, and fruit jars. Bridgeport was the shipping point for the county until the construction of a railroad in 1888.

The climate for the Bridgeport area of the Ohio River is temperate with seasonal variations in temperature. The area is geographically located in a region of variable air mass activity, being subjected to both polar and tropical continental and maritime air mass invasion. Although the weather is usually moderate, it may have frequent and rapid changes resulting from fronts associated with air mass movements. Measurable precipitation occurs approximately 111 days a year and amounts to approximately 40 inches. Temperatures range from an average of 22.0 degrees Fahrenheit (F.) in January to an average of 72.0 degrees F. in July.

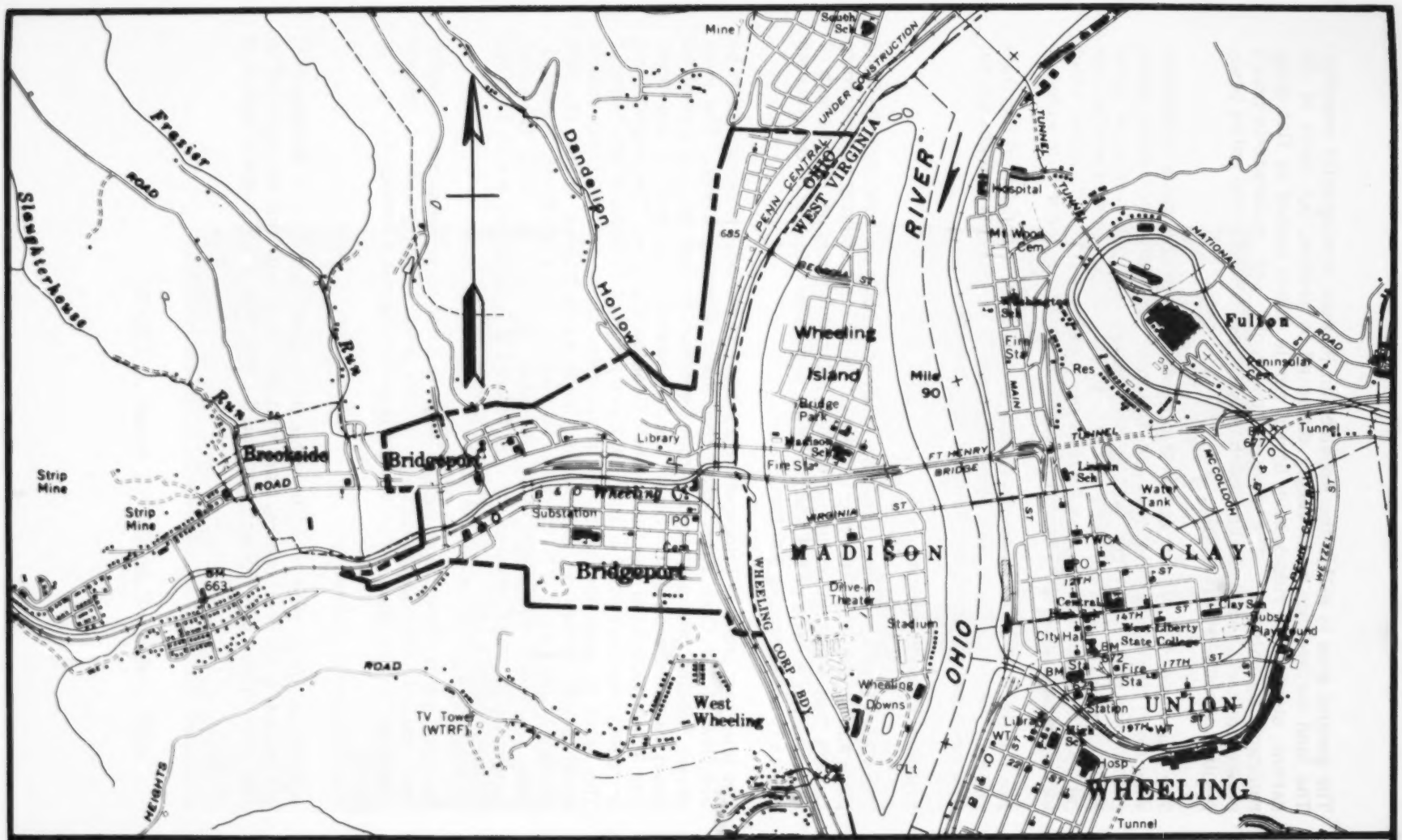

FIGURE 1

federal emergency management agency
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VILLAGE OF BRIDGEPORT, OHIO
BELMONT COUNTY

APPROXIMATE SCALE
2000' 0 2000' 4000' 6000'

VICINITY MAP

The general area is within the Appalachian Plateau physiographic province. The land surface has been deeply dissected by erosion, but many of the narrow, steep-sided ridges have broad, gentle crests caused by flat lying, resistant formations. The rugged topography and moderate-to-poorly permeable rocks that underline much of the area, as well as the entire basin, result in variable stream flow.

The Ohio River Valley from above Bridgeport to Pittsburgh has a moderately wide flood plain and a relatively low, flat river gradient. Local relief above the stream rises about 500 feet to an average hilltop elevation of about 12,000 feet. The average slope of the Ohio River approximates one foot per mile for the first 50 miles and 0.6 foot per mile for the next 75 miles, which includes the study area. The valley floor is approximately one mile wide.

For the most part, the flood plain along the Ohio River consists of highways and railroads. The flood plain along Wheeling Creek consists of highways but also contains residential and business development.

2.3 Principal Flood Problems

The Ohio River watershed within the study area has a moderately wide flood plain and a relatively flat river gradient. These are modifying and retarding factors that result in prolonged critical river flood heights. This reach of the river has a slope of 0.6 foot per mile, with local relief from the riverbed generally not exceeding 500 feet.

The low-lying areas of Bridgeport are subject to periodic flooding usually by overflow of the Ohio River and occasionally Wheeling Creek. The most severe flooding generally occurs from December through April as a result of heavy rain and snowmelt. Large floods, however, may occur at any time. The March 1936 flood was the greatest flood for this area. The largest flood or recent years occurred in June 1972 as a result of Tropical Storm "Agnes." The dates of peak and estimated frequencies under present flood control conditions for these and other major floods are as follows: March 19, 1936 (25-year), June 24, 1972 (45-year), February 7, 1884 (20-year), March 15, 1907 (15-year), March 28, 1913 (20-year), January 26, 1937 (15-year), December 31, 1942 (45-year), March 8, 1945 (15-year), and March 11, 1965 (25-year).

In recent years, flash floods on the small tributaries, in the summer months, have caused considerable damage in this area. Photographs of historic floods and future flood elevations are shown in Figures 2 through 6.

2.4 Flood Protection Measures

Approximately 32 percent of the Ohio River basin upstream of Bridgeport is controlled by 15 flood control dams that have been built and are operated by the COE. These dams, which were built from 1938 to 1974, are effective in

FIGURE 2. March 1964 Flood, Bridgeport, Ohio.

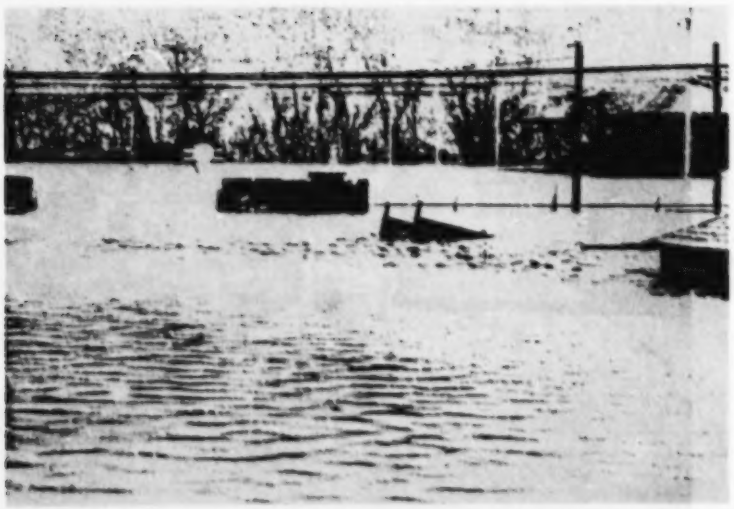

FIGURE 3. March 1964 Flood, Bridgeport, Ohio.

FIGURE 4. 100-Year Flood Elevation at Intersection of Lincoln and National Roads.

FIGURE 5. 100-Year Flood Elevation at Rear of Tuff Kote Building on Hail Street.

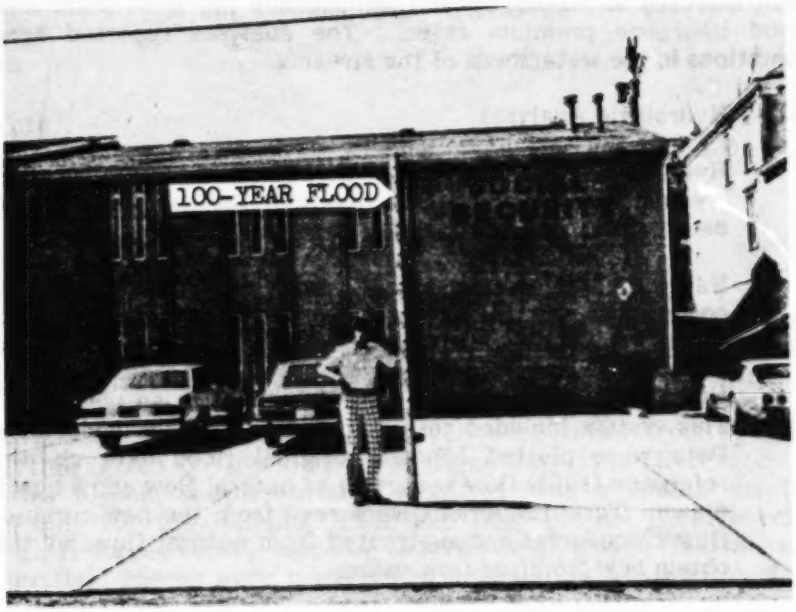

FIGURE 6. 100-Year Flood Elevation at Rear of Social Security Building on Hall Street.

reducing mainstem and backwater flood levels in the Bridgeport area from six to nine feet. There are no flood protection projects on Wheeling Creek.

3.0 ENGINEERING METHODS

For flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10-, 50-, 100-, and 500-years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the watersheds of the streams.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

Natural discharge-frequency curves on the Ohio River were developed in accordance with methods presented in a paper by Leo R. Beard, COE, Statistical Methods in Hydrology (Reference 12). Modified discharge-frequency curves on the Ohio River resulted from routing twelve representative floods for the Ohio River modified by an upstream reservoir system. This system included reservoirs completed and under construction in 1976. Data were plotted opposite original flood data on a grid containing a reference (1965) flow reduction of natural flow and a new best-fit curve was drawn. Total reductions were read from the new curve at selected natural flow frequencies and subtracted from natural flows at these frequencies to obtain new modified flow values.

On Wheeling Creek, the flows for the 10-, 50-, 100-, and 500-year floods were computed by a multiple regression formula developed by the Pittsburgh District COE (Reference 2). The formula is based on factors determined from a study of frequencies of small streams in the Pittsburgh District using drainage area, stream slope, and basin shape.

Gage readings were obtained at the Wheeling Wharf, 3.1 miles downstream from Lock and Dam 12 from March 1838 to July 1850 and from January 1861 to May 1911. Readings were taken at Lock and Dam 12 from May 1911 to July 1975 when the lock and dam was removed. Readings are again taken at the Wheeling Wharf but at a location different from that used previously. Records were maintained by the City of Wheeling prior to 1882, by the U.S. Signal Service from 1882 to 1891, by the National Weather Service from 1891 to 1911, and by the COE from 1911 to 1975. Records from 1975 to date are now maintained by the City of Wheeling.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each stream studied in detail in the community are shown in Table 1.

TABLE 1: SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK-DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
OHIO RIVER					
Lock and Dam 12	24,661	300,000	375,000	406,000	470,000
WHEELING CREEK					
Upstream Corporate Limit	107	6,500	10,500	12,800	19,200

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community are carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each stream studied in detail.

Cross section data for the Ohio River were taken from soundings and topography given on the COE maps dated July 1966 (Reference 3). For Wheeling Creek, supplementary definition was available on the COE topography for the Hannibal Lock and Dam Project (Reference 4), U.S. Geological Survey (USGS) mapping (Reference 5), and by field measurement. Further field checks were made if any information was questionable or if a reach required specific roughness inspection and evaluation. Bridge openings were field surveyed for structural geometry and backwater effects.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness coefficients (Manning's "n") for both streams were chosen on the basis of field inspection and on the verification of roughness requirements to reproduce profiles of known floods for which high water marks were obtained and flow quantities were measured or easily calculated. For the Ohio River, roughness values were 0.028 for the channel and ranged from 0.050 to 0.070 for the overbanks. For Wheeling Creek, roughness values were 0.030 for the improved reach of the channel and 0.045 for the unimproved reach of the channel, and ranged from 0.060 to 0.120 for the overbanks. The values used on Wheeling Creek were chosen to compensate for multiple-pier effects and alignment influenced by Interstate Highway 70 construction. However, due to the backwater from the Ohio River, the roughness coefficients were not too sensitive in profile determinations.

Starting water-surface elevations on the Ohio River were obtained by high water marks and a continuation of profile computations initiated far enough downstream to assure convergence at the downstream corporate boundary. Starting water-surface elevations for Wheeling Creek were based on coincidental flooding with the Ohio River. The exception to this was in the computation of the floodway which was considered independent of the Ohio River. Water-surface elevations for areas studied by approximate methods were gathered through the use of historical data, interviews with residents, and field investigations. The high-intensity short-duration storm of August 31, 1975 was also used as a guide in determining the area subject to flooding.

Water-surface elevations were developed using a HEC-2 computer step-backwater model (Reference 6). On the Ohio River, profiles were computed sufficiently beyond the corporate limits to verify additional high water marks to ensure consistent and compatible results with past or future studies in the adjacent reaches. When possible, profiles were determined for the 10-, 50-, 100-, and 500-year floods based on the timely reproduction of historical flood profiles. For the Ohio River, the well-defined floods of 1936, 1964, 1972, and the moderate flow of 1976, were reproduced successfully using the roughness coefficients stated above. For Wheeling Creek, profiles were based on field inspection inasmuch as no high water data were available. As mentioned earlier, the Ohio River appears most influential in governing the elevation of the Bridgeport reach and the absence of historical data is not considered significant.

Ohio River stream mileages, as depicted in this report, are "Official Stream Mileages" as agreed upon between Federal, state, and local agencies with jurisdiction within the study area. Therefore, measurable map distances between consecutive mile points may not scale exactly. Since Bridgeport is located along the back channel of the Ohio River, stream mileages shown are projections of main stream mileages and cannot be scaled directly.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles (Exhibit 1) are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps at a scale of 1:24000, with a contour interval of twenty feet (Reference 5). The approximate flood boundaries were also delineated using the above referenced topographic maps.

The boundaries of the 100-year and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations, and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazard in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. In Ohio, though, under the Ohio Flood Plain Regulation Criteria dated January 1976 (Reference 7), the encroachment in the flood plain is limited to that which will not cause an increase in stage of the 100-year flood of more than 0.5 foot (utilizing the "Equal Degree of Encroachment" principle).

The floodway recommended for this study was computed on the basis of equal conveyance reduction from each side of the flood plain. For the most part, however, encroachment could be allowed to tops of banks, in which case the equal conveyance method does not come into use. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
OHIO RIVER							
A	90.61[2]	1959[3]	76004	5.2	659.6	659.1	0.5
B	90.25[2]	2031[3]	84280	4.7	659.7	659.2	0.5
C	90.00[2]	2152[3]	86509	4.6	659.9	659.4	0.5
D	89.73[2]	1965[3]	78829	5.0	659.9	659.4	0.5
E	89.48[2]	2192[3]	84151	4.7	660.0	659.5	0.5
WHEELING CREEK							
A	0.195	68	870	14.8	636.6	636.6[4]	0.0
B	0.300	105	1230	10.4	639.5	639.2[4]	0.3
C	0.395	106	1235	10.4	640.4	640.2[4]	0.2
D	0.475	104	1220	10.5	641.0	640.8[4]	0.2
E	0.650	134	1535	8.3	642.9	642.8[4]	0.1
F	0.845	285	2710	4.7	644.2	644.2[4]	0.0

[1]MILES ABOVE MOUTH
[2]MILES BELOW HEAD AT PITTSBURGH
[3]THIS WIDTH EXTENDS BEYOND CORPORATE LIMITS
[4]ELEVATIONS WITHOUT CONSIDERING BACKWATER EFFECT FROM OHIO RIVER

TABLE 2

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VILLAGE OF BRIDGEPORT, OH
(BELMONT CO.)

FLOODWAY DATA

OHIO RIVER - WHEELING CREEK

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.5 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 7.

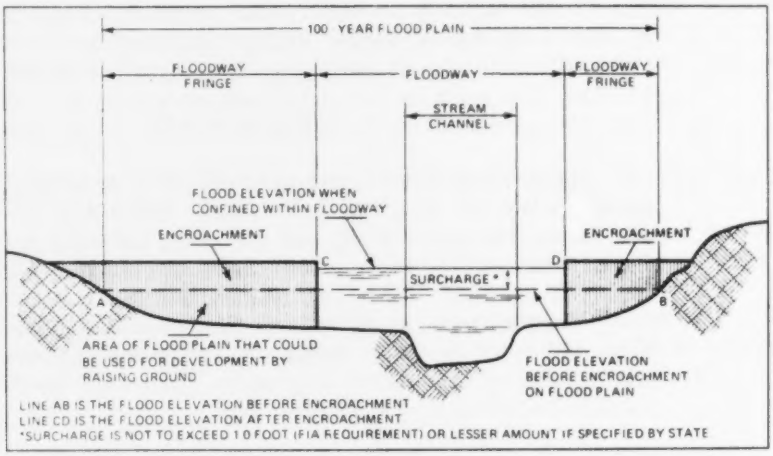
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FIGURE 7. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source affecting the Village of Bridgeport.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet

One reach for the Ohio River, which meets the above criteria, was required for the flooding sources of Bridgeport. The location of the reach is shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their Flood Hazard Factors are used to set actuarial insurance premium rate tables based on Flood Hazard Factors from 005 to 200.

The Flood Hazard Factor for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the Flood Hazard Factor is 005; if the difference is 1.4 feet, the Flood Hazard Factor is 015; if the difference is 5.0 feet, the Flood Hazard Factor is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the Flood Hazard Factor is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire incorporated area of the Village of Bridgeport was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or Flood Hazard Factors determined.

Zone A18: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factor.

Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Village of Bridgeport is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

A Flood Plain Information Report for the Ohio River through Belmont County was published by the COE in June 1971 (Reference 8). In this report, the profiles for the Ohio River show the 100-year flood elevations within the village are approximately 1.0 foot higher than the base flood elevations used in the present study. The earlier profiles were based on 1970 flood plain basin conditions and are superseded by the profiles in the present study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Regional Director, One Dearborn Street, Chicago, Illinois 60602.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
OHIO RIVER							
REACH 1	0001	–9.18	–2.88	4.85	090	A18	VARIES–SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

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VILLAGE OF BRIDGEPORT, OH
(BELMONT CO.)

FLOOD INSURANCE ZONE DATA

OHIO RIVER

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6. U.S. Army Corps of Engineers, Backwater Computation Program HEC-2.

7. Ohio Department of Natural Resources, Division of Water Resources, Ohio Flood Plain Regulation Criteria, 1976.

8. U.S. Army Corps of Engineers, Flood Plain Information Report, Ohio River, Belmont County, Ohio, June 1971.

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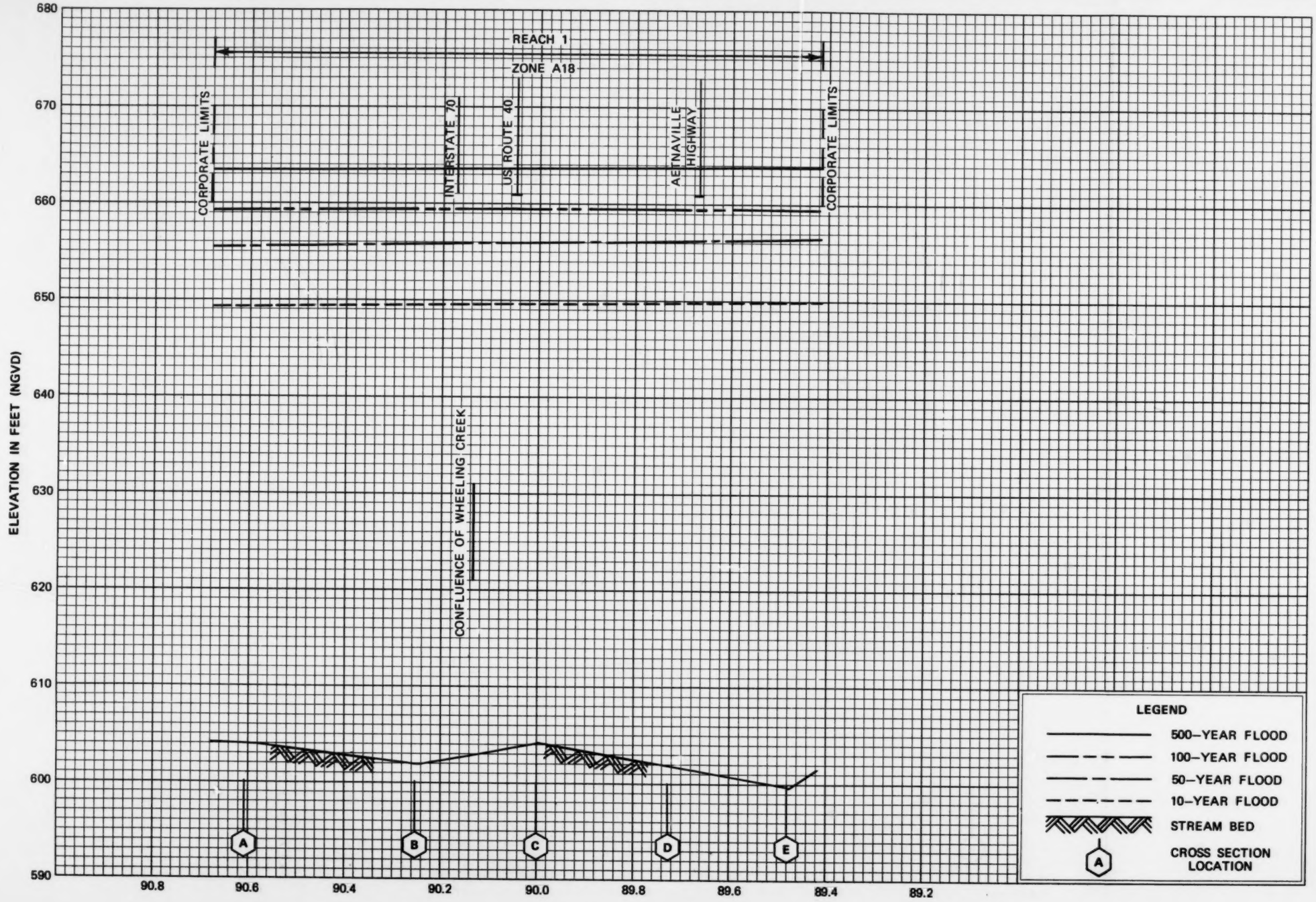

FLOOD PROFILES

OHIO RIVER

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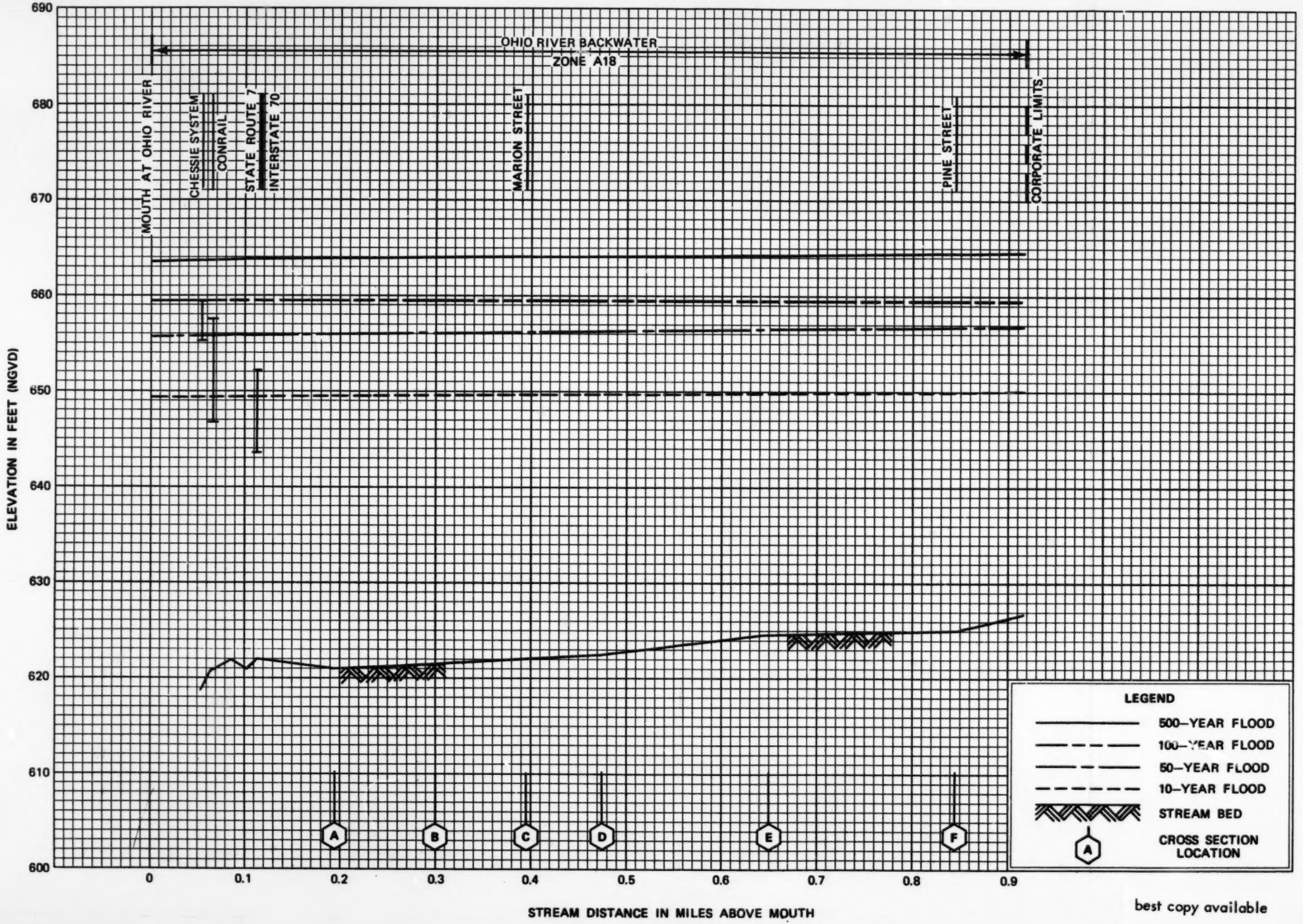
VILLAGE OF BRIDGEPORT, OH
(BELMONT CO.)

01P



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FLOOD PROFILES

WHEELING CREEK

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federal insurance administration

VILLAGE OF BRIDGEPORT, OH
(BELMONT CO.)

02P